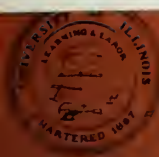


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Framework for Collecting and Analyzing Data on the
Provision of Public Education: An Efficiency-Based
Management Information System

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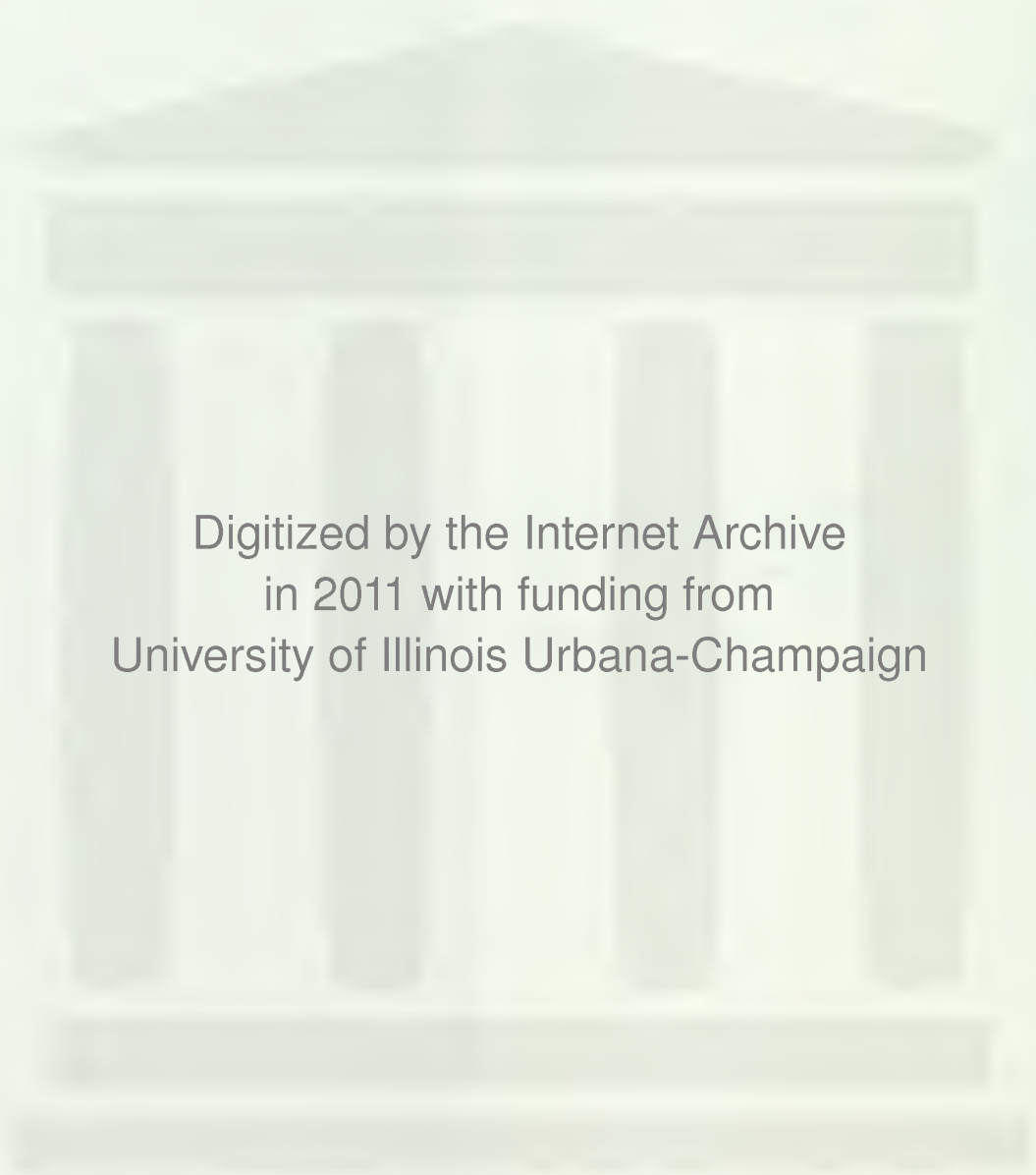
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September 1988

Framework for Collecting and Analyzing Data
on the Provision of Public Education:
An Efficiency-Based Management Information System

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Framework for Collecting and Analyzing Data
on the Provision of Public Education:
An Efficiency-Based Management Information System

Abstract

This paper develops a set of education indicators relating to inputs, processes, outputs, and ultimate outcomes of the education system. The framework that is provided has a coherent structure so that it is possible to use the data to establish trends and to make international comparisons in order to monitor the use of resources. Additional types of analyses are suggested that use the indicators to improve the cost/effectiveness, internal efficiency, and external efficiency of the educational system as part of a continuing process.

The Efficiency-Based Management Information System that is suggested is focused on the needs in developing countries, and particularly in Sub-Sahara Africa, but it could be adapted to other situations.

Framework for Collecting and Analyzing Data
on the Provision of Public Education in Africa

Walter W. McMahon*

In order to improve the link between government expenditures and the effectiveness with which education is provided, this "Framework" provides a structure for collecting the necessary data and a theoretical justification for the selection and anticipated uses of each defining indicator. It provides the basis for the creation of a more permanent Efficiency-based Management Information System that contains indicators of inputs, processes, outputs, and ultimate outcomes of the educational system. They have a logical relation to one another so that it is possible to use these indicators in the ways suggested to establish trends, make international comparisons, and seek to improve educational effectiveness, cost/effectiveness, and efficiency as part of a continuing process.

The "Framework" therefore focuses on improving the effectiveness and efficiency of the educational system so that resources are not wasted, but are instead used to their best advantage in attaining increased educational effectiveness. The importance of improving the efficiency of educational systems in Sub Saharan Africa derives not just from the immediate values of education per se, but also from the very important fact that expenditures are an investment with returns later. These returns occur throughout the life cycle of students as their productivity is raised, and as basic education permits a wider participation of individuals within the productive economy that

results in reduced inequality and a stronger middle class. The education of women (once it gets beyond 9th grade) is also known to have beneficial effects in lowering high fertility rates and in lowering high population growth rates. Given the serious needs for development, as well as the other positive contributions of education to the lives of individuals, it is particularly important that education be effective.

To maintain these contributions of education during periods of budget stringency, as well as to increase the effectiveness of education over time requires both internal efficiency and external efficiency as well as constructive innovation. A theoretical framework dealing with the logic of how these factors can be evaluated and what data is needed to do this will be presented first in Part I. This data will also permit determination of the level, trends, and trends in the efficiency in the delivery of education services in Africa. This is followed by a brief discussion in Part II of the opportunity for institution building, which is also an explicit goal of the UNDP project, see UNDP, Project Document, (1987, Part I, Sec. 1.5, p.3). Part III then considers each indicator of the level of education services, trends, and efficiency including possible sources and its specific justification in terms of the overall framework. Finally, Part IV suggests four of the major basic types of analyses to be done, all of which use the data.

I. Introduction and Overview

The analyses need to involve local counterpart nationals in establishing and using the Efficiency-based Management Information

System that is recommended so that they can gain experience in writing short policy papers implementing the changes in policy that are needed to improve efficiency.

A first and basic step in increasing and monitoring effectiveness and efficiency is to maintain and use quantitative measures of what services are actually being delivered. This is necessary to ensure simple accountability. But these same measures then can be used to achieve a second and higher level, that of cost/effectiveness which considers the relative costs of the services delivered and whether or not they are the types that are effective. The quantitative measures of services therefore have to be augmented with measures of their prices, or the outlay on these services to determine their costs. These costs in turn then have to be related to the outputs, or outcomes. At this point there is a pretty good basis for determining meaningful trends in cost effectiveness, for comparisons with the experience elsewhere, and for improving internal efficiency.

The third and final step necessary to achieving overall efficiency in strategies for investment in different levels and types of education are measures of the more ultimate outcomes or benefits of education. Internal data collected from within the education system must be supplemented with data collected externally--not just on the initial employment of graduates but on earnings and other returns over their entire life cycles. This is much simpler than it seems, because such data has already been collected by the Central Statistical Office in most African nations in periodic National Labor Force Surveys (or Household Income and Expenditure Surveys). All that is necessary in

most cases is a telephone call from the Minister of Education to the Head of the Central Statistical Office requesting a copy of the data diskettes from the most recent survey containing the raw data on individuals' education, earnings, sex, and employment for use in educational planning. This third step is not only essential for improving external efficiency and in encouraging Ministries of Education to be more responsible for their outputs in these very poor countries. But it also establishes the vitally important concept that educational expenditures are not basically a support for current consumption of families, but are instead an investment with returns later, including those in the form of increased productivity, faster growth, and more widely shared development.

Indicators within this conceptual framework helpful in monitoring the delivery of services, their efficiency, and the efficiency of investment strategies for human resource development include the following:

- (1) Inputs, such as number of teachers, teacher quality, teacher salaries, textbooks, textbook quality, textbook costs, number of students in average daily attendance, and fiscal resources,
- (2) Processes, such as number of years taken by students to complete each level, cycle costs, dropout rates, repetition rates, number of days per school year, number of hours per day, class size, curriculum content, and curriculum quality,
- (3) Outputs necessary to measure effectiveness, such as scores on achievement tests (preferably on a "value-added" basis), number of graduates, number completing a partial course, attitudes, and

- (4) Final Outcomes, such as employment, earnings, unemployment, search time, emigration of graduates, health, fertility rates, and nonmonetary outcomes of other types.

Overall efficiency of the educational system requires both internal efficiency as between inputs, processes, and outputs (#1, #2, and #3 above) and also external efficiency which is concerned more with whether the outputs meet the society's needs and growth bottlenecks (as between #1 or #3 and #4 above). The distinction between technical efficiency and price efficiency need not be stressed here because the cost/effectiveness and cost/benefit criteria developed as part of this conceptual framework already encompass both of these concepts, and because it is desirable that the framework not become complicated in light of the intended uses.

Many Sub Saharan African nations have very low per capita income, rapid population growth, low and sometimes even negative per capita economic growth, and great inequality in the distribution of income. In light of these acute needs, it is particularly appropriate that educational systems not waste resources through inefficient financing practices, or produce graduates at high cost in fields where they cannot be employed, or who emigrate. Instead, improved efficiency in human resource development, given that human resources are often the largest underdeveloped resource, is a viable strategy and one of those offering the greatest hope.

II. Institution Building Opportunities: Steps Needed at the Outset

Apart from data collection, an important objective of this project is institution building, and development of the capacities to analyze

the data and formulate policies on a contingency basis designed to maintain and improve efficiency.

For this purpose, it is necessary that an office be designated within each nation's Ministry of Education and Culture not only to collect the data, but also to analyze the results and to recommend policies on a continuing basis. This would normally be the Office of Research and Development within MOEC, or the Office of Educational Policy Planning and Evaluation. In no case is it acceptable that the task be delegated to a separate office or person responsible for "relating to donors." This latter arrangement is quite hopeless for developing a continuing Efficiency-based Management Information System for MOEC, or for developing policies designed to improve efficiency.

The data will be drawn largely from standard sources already available as well as data already available to the African Governments. In particular, the data should link to and should supplement that data in the World Development Report Appendices (1988, pp. 280-1) and the World Bank's Social Indicators of Development (1987, pp. 3-10). UNESCO publications are also widely available, and there are World Bank Education Sector Policy Papers (e.g., 1980) and African Education Sector Policy Papers that provide a base. But these will need to be supplemented by internal data available to the African Governments.

In particular, within the Ministry of Education, those responsible for administering the educational grants to localities (i.e., the school aid formula) should have data on attendance, teachers, financial resources, and teacher salaries. The Human Resources section of the Economic Planning Agency may already have much of the necessary

data. The data external to the educational system on employment and earnings must be for individuals (not for enterprises) obtained through the National Labor Force Survey by the Central Statistical Office. Sometimes the National Household Income and Expenditure Survey contains information about earnings, education, and employment instead of Labor Force Survey. The Income and Expenditure Survey is normally done by those responsible for the Consumer Price Index, which sometimes might be the Central Bank rather than the CSO.

For the purpose of building a longer run institutional capability for analyzing the data collected, monitoring the system, and recommending policies, it is desirable that at least one person collecting the data be one who has had formal training in the economics of education. Others can be trained over time. It should be recommended that others be sent for advanced training (with USAID or Bank support) in the Efficiency-based Management of Information Systems, in the Economics of Education, and in Educational Planning and Policy Studies. The combination of the charge to analyze the data and use it effectively, together with some encouragement and potential for longer term training (through contacts at USAID, the Bank, or UNDP) should help significantly in building a stronger longer term institutional capability.

III. Selected Indicators of Effectiveness

Indicators of effectiveness need to cover inputs and processes to ensure the delivery of services, as indicated above, and outputs and outcomes in order to provide a basis for evaluating (and improving)

effectiveness and efficiency. Since only one month is available for collection of this data in country, it is essential that the number of indicators be held to those that are the most critical for establishing the links between expenditure and effectiveness.

Suggested Coverage

With respect to time period, annual data is to be collected from 1975 through 1988. It would be desirable to start the worksheets for all indicators with 1965, and to then collect data for 1965 through 1988 where it is readily available. This latter will permit linking to the 1965 benchmark data in the World Bank's Social Indicators (1987) and World Development Report (1988, p. 280), as well as providing enough observations to run regressions.

With respect to geographic breakdown it is suggested that all indicators be measured on the basis of national totals. Beyond this, breakdowns for reach of the provinces, and by urban/rural are desirable. To get urban/rural differences, a stratified random sample considering of one major city in each province, and one rural district in another part of that province might be one possibility. To go beyond this in reporting geographical differences (or to try to collect too many indicators) runs the risk of causing the project to get bogged down in excessive detail, frustrating achievement of its goals.

Annual data for the nation with urban/rural breakdowns, and breakdowns by Provinces (where feasible) should be sufficient for establishing trends in the quantitative delivery of services and in cost

effectiveness. These then can be used for international comparisons and as benchmarks for comparisons later in particular local situations.

Input Indicators: Quantity, Quality, and Price

It is often necessary to judge the quality of a school or a university on the basis of the cost, quantity, and quality of its inputs, especially when there is no other information for use in evaluating processes and outcomes.

Research in developing countries in 24 multivariate studies reported by Fuller (1987, pp. 259-72) find that measures of simple inputs, especially those directly related to the instructional process, are consistently related to higher achievement. Student background and the assistance and encouragement provided by parents are important, of course (e.g., Coleman 1960), but more recent research finds that this is less important in the developing countries where the parents have less to provide (see Heyneman's, Shuluka's, and Loxley's studies cited in Psacharopoulos and Woodhall, 1985, p. 217 that include Uganda, Kenya, Ghana, and Somalia for example). It does emphasize the importance of controlling for the student's prior achievement and socioeconomic status. Focusing therefore on only those 26 multivariate studies that do control for prior achievement, and/or inputs from the parents using their social class as a proxy, the school inputs that are the most significant indicators of achievement as surveyed by Fuller (1987, pp. 257-73) are:

<u>Input Indicator</u>	<u>Number of Confirming Studies</u>
A. <u>Teacher quality</u> : Total years of schooling	12
B. <u>Teacher quality</u> : Years of tertiary and teacher training	22
C. <u>Texts</u> and reading materials	16
D. <u>Library size</u> and activity	15
E. <u>School lunch programs</u> (reduced malnutrition and dropout	5

Other input measures (apart from process indicators considered below) do not appear to have effects on achievement that are as well established as those above. Attention therefore is focused on the quantity, quality, and cost of the above inputs. Expenditures on "all other inputs" (some of which may be less productive) will be picked up as a residual, since total expenditure will also be collected, and the input mix analyzed. The list of specific input indicators follows, augmenting those above that research has established are effective, plus some covering innovations that seem to have potential:

- 1) Number of teachers, with part-time teachers converted to full-time equivalents (FTE). This should be by grade at the primary level, although the total number at junior secondary, senior secondary general, senior secondary vocational, and post secondary levels should be sufficient.
- 2) Number of years of teachers' schooling; the average number of years of formal schooling of persons teaching at each of the above levels.

- 3) Years of teachers' schooling that is at the post secondary level, or in teacher training institutions, at each level.
- 4) Average salary of teachers at each level.
- 5) Percent of teachers who are qualified vs. those underqualified (i.e., the percent possessing the academic and/or teacher training attainment appropriate to the assigned level, according to the Nation's standard at that level, which should be made explicit).
- 6) Teacher shortages, or surpluses at each level. This data is often available from teacher placement offices and from those doing the planning in teacher training institutions. The geographical breakdown is important.
- 7) Teacher specialization, especially the number of teachers at each level trained in mathematics and science. Overall surpluses or shortages can be accompanied by shortages that are more acute in science and mathematics.

Sources of Data on Teachers: The unit responsible for education grants to schools will have teacher pay scales, numbers of teachers, and schooling levels. This is usually MOEC, but may be in the Human Resources section of the Five Year Planning Agency, or in the Ministry of Home Affairs in some countries. The percent qualified, and standards for qualification may also be there, or in research units in the College of Education in each African nation.

Rationale. Teachers are the major input in the process, and their qualifications are related to achievement. Since most government pay systems reward higher levels of attainment, even though higher levels

of attainment give rise to better instruction and student achievement, to be efficient means that the marginal cost of the higher attainment qualifications is offset by the increased marginal output of the classrooms. If the rewards are insufficient, or excessive--either one--teachers' qualifications are not being rewarded in relation to their productivity and these false pay-level signals lead to wasteful choices.

This input data will also allow the establishment of trends (e.g., in teacher schooling, especially at the critical primary school levels), and for international comparisons (e.g., of teachers' salaries relative to the nation's per capita GNP).

There are many other teacher-related indicators, e.g., attrition, turnover, and age (as a proxy for experience), ethnic/nationality, but their significance is less clear when the concern is with efficiency. Many cut both ways, are not of established significance, or are picked up by other indicators.

The above indicators must serve as proxies for the teachers' subject mastery, and the teachers verbal communication ability, which are complementary to one another and critically important to student achievement. Anything that reduces the pool of bright young women qualified and wishing to enter teaching (e.g., teacher shortages, and/or few women completing secondary schooling) is likely to adversely affect the verbal ability and subject mastery of the new entrants, and hence to adversely affect the efficiency of the educational system.

Other important inputs include the numbers and prior background of students, the quantity and quality of textbooks, and innovative instructional materials. More specifically:

- 8) Number of Students in Average Daily Attendance (ADA). This is a critical element as a basis for school aid formulas (educational grants from the Central Government to schools) to provide incentives to the local schools to require and follow up on attendance. Opening fall enrollments can be very misleading, and must be supplemented with attendance records. Mid-year attendance, and attendance records for some time late in the school year are needed at a minimum, from which an average attendance can be computed.
- 9) Pupil background, measured in terms of the educational attainment of the parents (i.e., of adults age 20-35) in urban and rural areas, taken from the Census data for 1960, 1970, 1980, and 1988 estimates. For primary school pupils, there are no entering test scores so that increments in achievement and the cost effectiveness of the "value-added" by the school can be computed. Yet the inputs of the parents before and during school are important, and perhaps the educational attainment of the parents is the best proxy available. It is important to control for this prior achievement. It is meaningless, for example, to hold that better financed urban schools produce better graduates than do low cost rural schools when the concern is with cost effectiveness. There must be controls for the beginning achievement level of the students and at least the potential input from the parent's education so that the focus can be on the "value-added" by the school in relation to its cost.

- 10) Numbers of textbooks available in local schools at each grade level. It may be necessary to go to Provincial Departments of Education, and/or a sample of several urban and three or four rural schools for this data. Although this situation has improved dramatically in many developing countries due to the efforts, in part, of donors, in much of Sub Saharan Africa the conditions of textbook availability are still at a critical stage. In some cases (e.g., Liberia and Somalia) valuable textbook design efforts are frustrated by inadequacies in distribution due to finance, transportation, and management problems.
- 11) Quality of textbooks, difficult to measure without an assessment team. Suggested indicators are the origin and perhaps the average age of the major reading, social studies, and mathematics textbooks used in each grade. Those in MOEC responsible for supplying textbooks could report: 1) when the texts were last revised, and 2) the annual level of donor plus government support for textbook adaptation and development.
- 12) Number of Books in the School Libraries. Some schools will have no library, so the number will be zero. But this measure is appropriate for primary, secondary, and college level libraries and an aggregate of the number of books at each level should be available from those responsible for the libraries.
- 13) Number of books purchased for the libraries, 1965 through 1988. This is frequently an item cut back when financing becomes stringent, and should be a good indicator, obtainable at the same time from the above source.

- 14) Library Use. Number of students and/or faculty using each library. Since the pattern in Africa is frequently to study in and use books in the library rather than to charge books out, data, if it exists, on the number of persons entering and using the libraries would be better than circulation.
- 15) Innovations in Instructional Materials and Methods. Number of students reached through programmed instruction, often a substitute when teacher qualifications are inadequate. Where there are other educational innovations, such as radio instruction, again an estimate needs to be made by the students actually reached in significant ways. Computerized instruction, television, and video cassettes are other examples.

The availability of even the most basic equipment is still a rarity in the primary schools in most African nations. What equipment there is is likely to be found in the wealthier urban areas. Education indicators based on use of novel equipment in isolated locations are not likely to be very meaningful.

- 16) Number of children served by school lunch programs at primary, secondary, and college levels. Malnutrition is a serious cause of dropouts at the primary school level, and school lunch programs therefore can be viewed as a means of reducing this wastage. Also it is difficult for small children to travel longer distances (e.g., home for lunch), so school lunches are also a means of obtaining a somewhat longer school day, which is productive of greater educational achievement. Although justifiable at the primary and lower secondary levels, free or

highly subsidized meals which are common at the college and university level are very costly in that they forego the opportunities for resource recovery from the few who can best afford to pay, and are very wasteful of scarce tax dollars.

- 17) Number of schools at each level, from which school size (number of students in ADA per school) can be computed. The relation between school size and cost effectiveness is very complex. Larger size makes possible greater specialization and division of labor among teachers, leading to better quality outputs and economies of scale. But smaller size reduces travel distances for pupils, which are a problem in Africa where there are few buses in rural areas, and this reduces the implicit costs to students and parents and hence the dropout rates.
- 18) Number of desks, from which students per desk can be computed. This does appear to have a significant relation to achievement (e.g., Fuller, 1987, p. 260).
- 19) Number of classrooms, from which students per classroom can be computed. If this data on schools, desks, and classrooms can be found for each year, then the number of each added each year at each level can be computed, and related to capital outlays.
- 20) Educational attainment of the school administrator, measured as the number of years of schooling of primary and secondary school headmasters and of college administrators. Administrative competence is important in determining the performance of the best and worst schools (a conclusion reached in separate studies by Paul, IEES, and by Glasman cited by Windham, 1988,

p. 43). But it is hard to measure directly. Years of administrative skills and planning are also relevant to competence, but are less likely to be available on any consistent basis.

- 21) Current public operating expenditures for Education at public and at private institutions and at primary, junior secondary, senior secondary general, senior secondary vocational, and tertiary levels are essential. This data must be collected, in part from World Bank and International Monetary Fund (1988) sources, and should include public funds from state and local sources. Total public operating expenditures need to be broken down by outlays for teachers, outlays for textbooks and instructional materials, outlays for libraries, and all other), not including capital expenditures, (see below).

Geographically nationwide expenditure is needed, but also by Provinces, and by urban/rural (or village) schools at the primary level. Room and board expenditures by the government which are quite substantial in some African countries at the secondary level also definitely need to be separated out and shown.

Little expenditure detail is normally available (e.g., staff, equipment, materials), and sometimes unfortunately will be for amounts budgeted rather than amounts actually spent. But it is more important to get comprehensive operating expenditures with teachers salaries separated out by level and type of education than it is to get excessive amounts of detail at this stage.

- 22) Private expenditures by parents on education at primary, secondary, and tertiary levels on tuition and fees, books, uniforms, and lunch. These are a vitally important element in doing a logically coherent cost/effectiveness or cost/benefit analysis (foregone earnings costs can be calculated from the earnings data, Indicator #33).

There is an issue with respect to private room and board costs for (usually) secondary school pupils, since their overlap with foregone earnings costs would constitute double counting. It is recommended therefore that they be omitted.

The most feasible way to calculate these costs is to do it on a per student basis, for each of the levels of education indicated, as well as for urban/rural (or village) schools.

- 23) Capital expenditures by the government at public and private institutions. Data on capital expenditures separating buildings and equipment will be collected from sources already available at the World Bank and local sources. It needs to be broken down by level (primary, lower secondary, senior secondary, and higher education), as well as by Province and for urban/rural.

The evidence that physical facilities have any significant connection to educational achievement is very limited, so fewer indicators are warranted. The data is also frequently not likely to be available.

There are hundreds of more measures of inputs that could be collected of facilities (e.g., labs), equipment (e.g., vocational/technical metal and woodworking machines), and administrative capacities (e.g., number of secretaries). But they are less important than those listed above, meaning that they are less closely related to achievement and also it is less likely that they will be used. To expand the list (given the limited one month time frame) for collecting data runs the serious risk of letting the project get bogged down in a sea of detail, thereby failing to achieve its goals.

Process Indicators

From the extensive research on wastage and repetition carried out by UNESCO (1977, 1982) and summarized by Haddad (1979), it is evident that the problem of wastage and repetition is serious throughout Africa. High dropout rates after first grade, and repetition rates that average 17 percent after each grade in East African nations and 27 percent after each grade in West Africa constitute serious sources of internal inefficiency.

Unfortunately most African nations have no accurate information on dropout and on repetition rates. A device that can be used to estimate this wastage is a flowchart that shows the progression rate between grades. With data on enrollment in each grade (e.g., grades 1 through 16), the enrollment in grade 6, for example, can be expressed as a percent of the enrollment in grade 1 six years earlier. The percent who did not make it to 6th grade have either dropped out, or are still repeating intermediate grades, constituting wastage and internal inefficiency.

The indicators needed therefore are:

- 24) Dropout rates, especially for grades 1 through 9, from 1965 through 1988, but see #24.
- 25) Repetition rates, but see #24.
- 26) Enrollment in grades 1 through 16, separately for general and vocational/technical schools, male and female, and at public and private institutions. This can be used to calculate progression rates, as described above. Since dropout and repetition rates are unlikely to be available, these progression rates are the best substitute.
- 27) Number of school days in the year, not including holidays, which when excessive can lead to much lost time.
- 28) Number of hours in the school day. Both of these are related to the length of the instructional program, which research surveyed by Fuller (1987, p. 260) indicates is very significantly related to achievement.
- 29) Number of years taken to complete the course by graduates, primary, secondary, and Bachelors Degree levels. This is a very important index of efficiency, or lack thereof, and needed to compute cycle costs. It is available from interviews, or from tracer studios, if any.

Homework frequency. It is unlikely that data on this over time will be found, and therefore it is not included in the list of indicators. But it is related to learning effectiveness (Fuller, op. cit., p. 260), and some isolated benchmarks might be found.

There are many other process indicators that would be useful, but on which data is not normally collected by schools, preventing their inclusion. They include a) involvement by administrators of parents in the educational process, b) pupil time-on-task, c) teachers expectations of pupil performance, d) teachers time spent in class preparation, and e) teacher absenteeism, among others. In the absence of data on these processes, the assumption usually is that input measures such as the quality of the teachers and of the administrative staff can serve to some extent as proxies for these hard-to-measure processes (over time, and nationwide) that are related to achievement.

Output Indicators

Input and process indicators, even though carefully chosen to be the items most clearly related to accountability and to effectiveness are still only lower level partial measures of the overall cost effectiveness and efficiency of the educational services delivered. The logic of any framework seeking cost effectiveness and efficiency requires that there also be measures of outputs, including 1) years of schooling attained, 2) achievement effects, 3) attitudinal effects, and 4) equity effects, as well as measures of the more ultimate outcomes. At this point the costs of the inputs, calculated from the input indicators, can be related to what the schools and colleges actually produce. The result is much more powerful economic criteria for monitoring the cost/effectiveness and cost/benefits of the system. This in turn results in a larger potential contribution made per "dollar" invested to growth and to equity.

Output indicators to be collected include:

- 30) Number of graduates, at primary, secondary, bachelors, and higher levels, male and female, at public schools and colleges. Progression rates based on enrollment also measure attainment. But the collection of enrollment data was provided for above under the heading of "process indicators" because of the emphasis there on also measuring wastage. But the number graduating from primary, junior secondary, senior secondary, and college levels can differ from the number enrolled.
- 31) Number graduates of private schools, at each of the above levels.
- 32) Test scores on nationwide standardized tests, by school. These are usually administered at the stage of completing primary, lower secondary, and senior secondary levels. Although these school-leaving exams are not perfect measures of knowledge or achievement, they are a very useful indicator. So long as they are not used as the sole basis for evaluation, achievement test information is a vital element in improving the quality and cost effectiveness of local schools. It is therefore important that these examination scores be cross tabulated with student (or parental) characteristics and school characteristics in order to control for differences in the student's prior achievement and parental inputs.
- 33) Equity: The Distribution of Expenditure Per Pupil Among Schools. A Gini coefficient measuring the degree of inequality (see Windham, 1988, pp. 175-6) is the best measure. It can be calculated later if the data collected shows the number of

pupils attending schools in each quintile of expenditure (i.e., expenditure per pupil divided into five equal amounts).

34) Equity: The Distribution of Achievement Levels Among Pupils.

Again the Gini coefficient of inequality is probably the best single measure. It can be calculated later if the data shows the number of pupils within each of five equal subdivisions of the range of test scores.

In nations where national test data exists, it will normally be found in the Center for Testing and Evaluation in the Ministry of Education.

Final Outcome Indicators

Although there are many influences other than education that affect later outcomes such as employment and earnings, influences that include luck and pure chance, many of these influences net out when averages are computed for individuals grouped by education level. A preponderance of the 16 more recent research studies surveyed by McMahon (in McMahon and Geske, 1982, pp. 181-2) find that the proportion of earnings differences due to education (the alpha coefficient), after controlling for ability and averaging out various other factors, is overall about 90 percent, and even closer to 100 percent at the primary level taken alone. The time lags in the process that connects education now to employment and earnings later is clear evidence that the direction of causation flows from education to earnings, not the other way around, even though it is simultaneously true that larger earnings by parents earlier made a larger investment in education possible in the first place. As a final step, the outcomes of employment, earnings, and better health are a major part of increased

productivity where averages of groups of individuals are involved, for here also there are some slips between the cup and the lip. The connection between educational investment and productivity growth directly skipping intermediate issues about earnings has been found to be highly significant for 1975 through 1985, especially for investment in primary education (see McMahon, 1987, p. 189). The contribution of education undoubtedly would be greater if the internal and external efficiency of the educational system could be improved.

Within this framework, the measures of final outcomes needed are as follows:

- 35) Earnings, by Education Level, by Age, by Sex.
- 36) Employment, by Education Level, by Age, by Sex.
- 37) Unemployment, by Education Level and Type, by Age.
- 38) Underemployment, by Education Level, by Age.
- 39) Number of children, by Education Level of the Mother.

All of this data on outcomes can be obtained from a single source, a copy of the data diskette for the National Labor Force Survey (or the Household Income and Expenditure Survey in the event that the Labor Force Survey did not collect data on earnings). A major effort should be made to obtain a copy from the Central Statistical Office for continuing use by the Ministry of Education. This contact should be made immediately, at the beginning of the data collection process, because although the mechanical problems of copying the diskette and code sheet are negligible, obtaining the permission from the head of the Central Statistical Office may take time.

There are other measures of outcomes that are sometimes used, such as admission to and achievement in higher levels of education. But as

pointed out by Windham (1988, pp. 80-81) there are major possibilities for misinterpretation. The decision to continue into postsecondary levels is more dependent on the parents' income than anything else, for example, and can be a very misleading indicator of a school's effectiveness. Since this study covers all levels of public support of education including higher education, it is better to have data on what happens to all persons after they leave school (as in #33-#37 above), and subsequent education as an indicator of educational outcomes will therefore be omitted.

Similarly, there are various effects of education on attitudes, as well as external spillover benefits to the society. The latter can be either monetary or non-monetary, but they should not be confused with non-monetary private satisfactions received by the individual. The distinguishing characteristic about externalities is that they are not and cannot be captured by the individual. Research on externalities reviewed by McMahon in "Externalities in Education" in Psacharopoulos ed. (1988, pp. 133-7) indicate many types, among which three are of particular relevance in Africa and therefore are desirable to include among the output indicators. They are:

- 40) Research relevant to solving the nations problems done at educational institutions. This problem solving research generates externalities that aid development but that are not fully captured within the pay scales or during the lifetime of individual researchers. Yet this is a major output of higher educational institutions in Africa that must not be ignored.

To measure this it is suggested that attention be confined to data on user driven research at the higher educational institution(s) in each African nation. By user-driven research is meant grants and contracts (for the solution of clearly defined problems) made by the African government and other donors to educational institutions. (Non user-driven research is less likely to be relevant to the nation's development needs, and would also be much harder to separate out from other operational expenditures.) The data needed here should cover:

- a) Grant/contract research expenditures, 1965-88.
- b) Number of full-time-equivalent research workers supported by these funds.

The Director General's or Assistant Minister's Office responsible for higher education budgets is likely to have this data.

- 41) Enhanced productivity of physical capital, a very important external benefit of having a trained labor force and the capacity to maintain, operate, and disseminate the use of capital equipment. Otherwise diminishing returns to physical capital investment sets in. To measure this it is suggested that data be collected for each nation from 1965 through 1988 on Gross Domestic Investment as a percent of GDP from the World Development Report (1988, p. 230, Cols. 5 & 6, and earlier issues). This can later be expressed in relation to the government's investment in education as a percent of GDP, all of which can also be compared across nations and included in regressions.

42) Development of political democracy, for which as Jefferson pointed out, the education of farmers is a critical element. There is no good single indicator for democratization. However one measure might be the basis being laid for decentralization and community participation within the educational system itself. Perhaps data exists on

- a) The number of locally elected school boards, or school committees.
- b) The number of school boards with the power to set a local property tax rate with the proceeds earmarked for the use of the local schools.

The number under 42b) is likely to be zero in many cases, but nevertheless this would be a very significant indicator of progress toward a degree of decentralization and local self governance within the education system. Where there is a significant local financial stake and involvement in school decisions, there is more incentive for effective local policing of the system and greater incentives to increase its efficiency.

IV. Types of Analyses to be Performed

The central objective of this logical framework for collecting and analyzing data is to enable analysts to establish a link between the central government expenditures on education and the delivery of education, including educational outputs and outcomes, in order to improve the efficiency of the system throughout.

A secondary objective is institution building. This involves using these indicators to create an efficiency-based Management Information System (EMIS). It also requires that counterparts be designated to collect the data who will have a continuing interest and responsibility for using it to monitor the efficiency of the system. They also should have the responsibility of conducting analyses that are written up in short policy papers that recommend policies designed to improve its efficiency. There will be some learning and training involved as the World Bank representatives help to arrange for getting the data collection started and the EMIS system set up. Individuals can be identified for further training in the economics of education and in efficiency-based educational planning.

The analyses actually performed will have to depend on the quantity and quality of data that are actually collected. But the following types of analyses should be possible:

(1) Growth in the Provision of Public Education, at primary, secondary, and tertiary levels. Indicators such as number of pupils (in ADA), number of teachers (FTE), and number of textbooks are measures of key inputs that are more closely related to the production and delivery of outputs of educational achievement. Indicators of the quality of these inputs can also help to establish trends over time, permit international comparisons, and in relation to expenditures on these items, facilitate monitoring.

Population growth needs to be taken into account however. In most of these African countries it is rapid, putting tremendous pressures on the financial resources available for schools. The result is that

although the total number of children served and the total amount of education delivered has grown, the financial constraints have led to a deterioration in quality of education per pupil. So part of the analysis needs to be on a per pupil basis, and to consider population growth.

Recent research finds that it is only after the education of females goes beyond 8th or 9th grade (so that they have options available other than work in agriculture) that fertility rates start to fall. Before that level, the converse is true; as women get a small additional amount of education, the health of their children and survival rates improve, so that population growth rises. Many Sub-Saharan African countries therefore have a long ways to go before the necessary education level of women is achieved and the beneficial effects of women's economic contributions outside of agriculture and on the population growth rates are evident.

The financing arrangements can encourage inefficiency and wastage. For example, if the education grants to local schools are not on the basis of the number of children in average daily attendance, but instead merely reimburse teachers salaries and/or pay on the basis of enrollment, the incentive to maintain enrollment is weak. One study should focus on the relation between the financing formula used and drop out rates, as well as cycle costs.

(2) Improving Cost/Effectiveness. Studies of specific measures of cost/effectiveness across schools, over time, or comparing alternative policies need to be written up in short policy papers focused on describing the nature of the cost ineffectiveness and on possible

policies for improving it. Cost effectiveness analyses go beyond the steps to improve effectiveness based on the indicators in part (1) above by adding considerations of educational costs, and relating these to the effectiveness and output measures. The result is a much more powerful tool for improving efficiency.

Data on costs alone is largely meaningless, taken in isolation. Some activities that are high cost may be very cost/effective, and activities that are low cost can also be quite cost ineffective and wasteful. The primary purpose of cost analysis is to produce cost figures for use with effectiveness measures. The result is indicators of educational efficiency. For detailed description and methods of implementation of unit cost and cycle cost analyses, see McMahon, Millot, and Eng (1986, pp. 248-404).

Individuals such as teacher cost per student, cost for achieving a given level of knowledge as indicated by test scores, or cost per graduate can be very revealing when compared across schools at a given level that are in comparable situations, or across time.

(3) Allocative Efficiency Indicators relate the cycle-cost of the education at any given level to the outcomes, such as earnings over the life cycle of the school leavers at that level. This latter data is obtained by applying a Statistical Package for the Social Sciences (SPSS) program to obtain the necessary breakdowns from the data diskette containing the National Labor Force Survey data for individuals. What is needed is a breakdown of earnings, by age, by sex, by industry (or occupation including farm/non-farm).

The earnings data for 10 year age intervals at each education level then can be inserted in a data diskette supplied by the author and used with LOTUS 123 (eventually by the African counterparts) to compute all of the relevant cost/benefit ratios, and social rates of return that serve as relatively sophisticated efficiency indicators. The method and calculations done by the PC Program and described in detail in McMahon, Millot, and Eng (1986, pp. 214-233). Care must be used both to sort the data and in interpreting the results of course. Rural earnings are not good measures of the contribution of education to agricultural productivity, for example (since farm prices are artificially depressed by governments in many African nations, and since also much farm income is non-market and in-kind). However, there are other surveys of the contribution of education to agricultural productivity (using physical measures of farm output) that find social rates of return to education to be in the variety of 27-29 percent in agriculture. (See the recent survey of the research findings by M. Lockheed in Psacharopoulos, ed. (1988, pp. 110-116.)

If used with discretion and thoughtfulness, these rates of return can be related to achieving more efficient investment strategies conclusive to the attainment of faster economic growth. Taking costs into account, as well as returns to education over the life cycle when deciding whether to expend vocational/technical education or general junior secondary education for example can be very revealing. Many of the heavy handed central economic planning and manpower requirements planning approaches that drive the educational systems in

many African nations do not consider the costs of the various alternatives much less the prospective returns throughout later ages in the life cycle.

(4) Production Function Studies. A fourth type of analysis that can be done using these indicators is the estimation of education production functions which relate inputs (e.g., of teacher time, student time-on-task, textbooks, financial resources invested) to outputs (e.g., numbers of graduates, achievement test scores) and/or to ultimate outcomes (e.g., to earnings and employment). There are three levels at which these input/output relationships can be analyzed, those relevant to internal efficiency, to external efficiency, and to efficient investment strategies. A few suggestions relevant to each using this African data follow.

First, the relationship is quite complex since factors related to the students' background such as ability and the amount of educational assistance contributed by the parents is very important. If the purpose is to evaluate the effectiveness with which individual schools or school districts use resources, such production function studies should not be conducted unless measures have been obtained during the data collection process of the initial ability level of the students in the school and/or the educational/economic capacities of the parents. Then the "value added" (e.g., the increment to achievement test scores, indicator #32) can be made the dependent variable, and/or the parents' education level (indicator #9) or socio-economic status can be inserted in the production function to control for the influence of this factor. See Psacharopoulos and Woodhall (1985, pp.

215-224) for further discussion, and Fuller (1987) for some excellent examples. Where nationwide production functions are used to explain productivity growth, as in McMahon's (1987) study of 30 Anglophone and Francophone African countries, these controls for differences in parental inputs are not necessary, but controls for investment in physical capital in particular as well as for the shorter run impacts of recessions emphatically are necessary. No production function studies without these controls are worth further attention.

Second, there must be a large enough number of observations to meet the requirements of sampling theory. For this reason, if the key variables to be used cover the period from 1965 through the present it would be better. The cross section and time series data sometimes can be pooled to increase the number of observations, but there are also some costs of doing this.

Third, internal production functions relevant to interval efficiency can then express outputs (such as numbers of graduates or achievement levels which reflect education services delivered) as a function of teachers, the education level of teachers, textbook availability, and other inputs while controlling for the students' prior achievement levels and the parents' education.

Fourth, production functions can use earnings as a measure of one ultimate outcome of education taken from the National Labor Force Survey data (indicator #35 above), and express this as a function of the number of years and type of schooling, time, and time squared (using age to measure this), and weeks worked. This is a Mincer earnings function, and is an alternative method of estimating the rate of return to investment in education in each African nation.

Finally, an aggregate production function can be estimated where the dependent variable is the rate of growth of real gross domestic product in each African country. The explanatory variables then would be investment in physical capital as a percent of GDP (indicator #41) to control for the effects of physical capital. In addition, investment in primary, secondary, and higher education separately, all as a percent of GDP (from indicator #21 above), and the population of working age (from the World Development Report (1988, p. 282)). The method is described further by McMahon (1987). This gets at the crucial relative contribution of investment in education at each level, (relative to investment in physical capital), to per capita economic growth. This is stressed as a very important ultimate objective of an efficient human resources investment strategy by the World Bank's policy papers on Education in Sub-Saharan Africa (1987, pp. 6-7) and on Rapid Population Growth in Sub-Saharan Africa (1983).

Many other kinds of analyses can be done designed to improve the efficiency with which financial resources are used to produce effective educational outcomes. Excessive subsidies to students in higher education can be associated with excessively long times taken to complete standard degree programs for example, as to the number of students seeking admission and to the numbers of college graduates remaining unemployed or migrating. The effect of budget cuts via reduced investment in human resources on growth rates can also be traced, and the long run effects predicted.

There is a great opportunity in this project to assist in creating a longer run capability to improve the efficiency of the human

resource development system within each country. However, counterparts must be identified who have the background and support for a longer term commitment. Then an Efficiency-based Management Information System (EFIS) can be institutionalized, and left for each government to develop further and use for continuing to improve the efficiency of its educational system.

APPENDIX A

Education Indicators Needed for an Efficiency-Based
Management System

All Indicators are important, but Core Indicators have been marked with an Asterisk(*).

I. Input Indicators

- * 1. Number of teachers
- * 2. Number of years of teachers' schooling
- * 3. Number of years of teachers' schooling that is either in teacher training institutions or post secondary
- * 4. Average salary of teachers by qualifications
- 5. Percent of teachers who are "qualified"
- 6. Teacher shortages (or surpluses)
- 7. Teachers specializing in math or science
- * 8. Number of students in ADA per school
- * 9. Educational attainment of the parents in each school
- *10. Numbers of textbooks, and their urban/rural distribution
- 11. Quality of textbooks
- *12. Number of books in the school (college) library
- 13. Number of books purchased for the library
- *14. Library use--number of persons
- 15. Innovations in instructional materials
- *16. Number of children served by school lunch programs
- *17. Number of schools that are reasonably "complete"
- 18. Number of desks
- 19. Number of classrooms

- 20. Number of years of schooling of the school administrator
- *21. Current public operating expenditures for education at each level at public and at private institutions
- *22. Private expenditures by parents on education
- *23. Capital expenditures by government on buildings and on equipment

II. Process Indicators

- *24. Dropout rates
- *25. Repetition rates
- *26. Enrollment in all grades, public and private schools, male and female (or else gender ratios)
- *27. Number of school days per year
- 28. Number of hours in the school day
- *29. Number of years taken to complete primary, secondary, and college (bachelors) levels

III. Output Indicators

- *30. Number of graduates at primary, secondary, and higher levels, public
- *31. Number of graduates at each level, private
- *32. Test scores on national examinations
- *33. Distribution of expenditure per pupil, including urban/rural
- 34. Distribution of achievement levels among pupils

IV. Final Outcome Indicators

- *35. Earnings by education level by age, sex, and urban/rural
- *36. Employment by education level
- 37. Unemployment

- *38. Underemployment by level of education from 0 through 16
- 39. Number of children by education level of the mother
- 40. Research grants and contracts in higher education
- 41. Gross domestic investment (in physical capital)
- 42. Number of locally elected school boards or committees with the power to set a local property tax rate earmarked for the local schools

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Footnote

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